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THE TISZALOK DAM

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Canalization of the Tisza

The canalization of the Hungarian section of the Tisza River is the prerequisite for the irrigation of that part of Hungary which lies east of the Tisza and is known as the Trans-Tisza Region. Full utilization of the water of the Tisza naturally requires the construction of several dams.

Preliminary investigations led to the conclusion that two dams would be insufficient, because they would not provide a satisfactory waterway for navigation. On the other hand, five or more dams would be uneconomical for power production and would also slow down navigation because of the delays at the locks. Thus, a comparative study was made between the four-dam and three-dam systems and the results of the investigation were in favor of the latter.

The best location for the uppermost dam appeared to be below the mouth of the Bodrog River, near Tiszalok, and for the lowest dam, near Szeged. For the locations of the intermediate dams, Tiszabo was selected for the third dam in a three-dam system and Tiszavezseny, for the fourth dam in a four-dam system.

Careful investigation of hydrological conditions and water utilization suggests that no important difference exists between the two systems as far as full utilization of the water volume is concerned. However, capital investment in a four-dam system is much greater, and for this reason, the three-dam system was adopted. Figure 1 shows a schematic diagram of the three-dam system which was adopted for the canalization of the Tisza.

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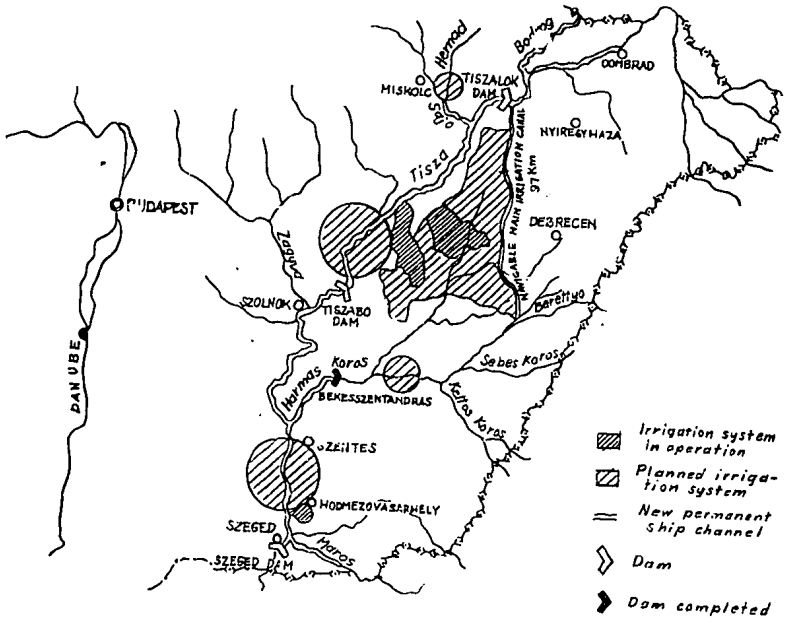

Figure 1. Schematic Sketch of the Proposed Tisza Canalization

After the completion of the three dams, the canal systems, and the pumping stations, an area of approximately 350,000 hectares can be irrigated in the drought-stricken Trans-Tisza Region.

One of the major constructions in the entire canalization project, in addition to the three dams, is the main Trans-Tisza shipping and irrigation canal, which will start at the Tiszalok dam; run 97 kilometers in a north-south direction; pass through Hajdunanas, Balmazujvaros, and Hajduszoboszlo; and enter the Berettyo River near Bakonyszeg. It will follow the western rim of the high ground, which includes the Nyirseg hills and the plateaus near Debrecen. West of this high ground is located a large area of the Tisza Valley. This area can

be irrigated by gravity from the main canal, which will border and dominate it. The main canal, with a capacity of 60 cubic meters per second, will provide an excellent waterway for 1,000-ton barges (Figure 2).

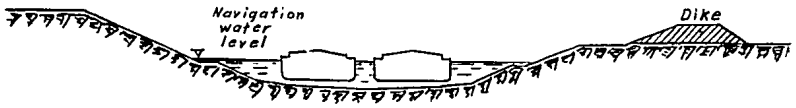

Figure 2. Cross Section of the Main Canal

Canalization will not only transform the Hungarian section of the Tisza into a first-class waterway as far as Dombrad, but it will also improve navigation conditions in the lower sections of the Maros, Koros, and Bodrog rivers. All in all, the canalization of the Tisza will create first-class, permanent waterways with a total length of 535 kilometers.

Each of the three dams will be equipped with a hydroelectric power plant. Although these plants, because of the small drop, will not have a high output, they will still be important, because they will supply cheap power in a part of the country which is poorest in power resources. Moreover, the three hydroelectric power plants will save 25,000 carloads /250,000 tons/ of coal per year for the national economy.

The canalization of the Tisza River includes various additional projects, the most important of which are the following: (1) utilization of the groundwater supply and medicinal and mineral waters; (2) improved flood control; (3) development of the irrigation system; (4) soil improvement and conservation; (5) construction of fish ponds and reservoirs for the storage of irrigation water; (6) purification and distribution of drinking water and industrial water; and (7) drainage and disposal of industrial and urban waste water. An additional objective of the canalization project is afforestation, which has a dual hydrological effect: (1) it reduces soil erosion; and (2) it increases the water-storing capacity of the soil.

Plan of the Tiszalok Dam

The primary considerations in choosing the vicinity of Tiszalok for the site of the dam were:

1. It is located below the mouth of the Bodrog River and, therefore, the water of the Bodrog can be utilized.

2. It is suitable for the necessary water level of the main canal, which supplies the western basin of the Trans-Tisza Region by gravity.

3. The ground conditions are suitable.

4. The dam can be constructed safely without flood and ice-obstruction hazards.

5. These considerations led to the selection of the Razompuszta bend near Tiszalok, where the dam installations and the two openings of the main canal have been located (Figure 3).

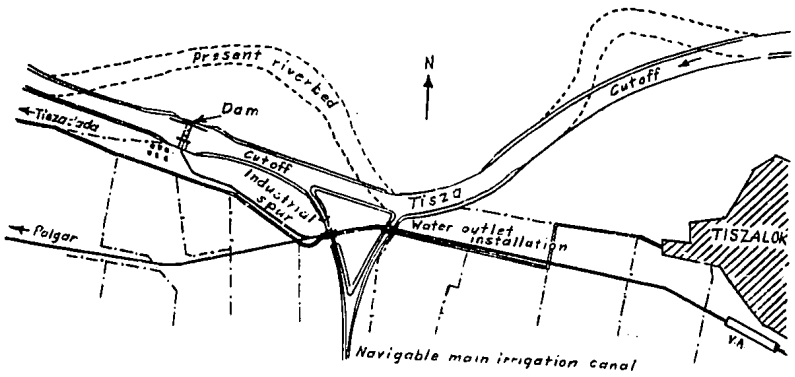

Figure 3. Topographic Sketch of the Tiszalok Dam

The basic idea of the plan was to place the dam installations in a new channel (the so-called cutoff), instead of the present channel of the Tisza. The new channel will be opened only after the completion of the entire project. In the meantime, the Tisza will flow in its present bed. Construction work, then, will not be performed in the active river bed, but in the area between the flood-control dikes close to the left, or high, bank. After the completion of the dam and the cutoff, the present channel of the Tisza will be closed.

The Tiszalok project consists of the following main parts and installations: (1) the main lock; (2) the hydroelectric power plant; (3) the ship lock; (4) the housing project; and (5) the lock at the shipping and irrigation branch of the main canal.

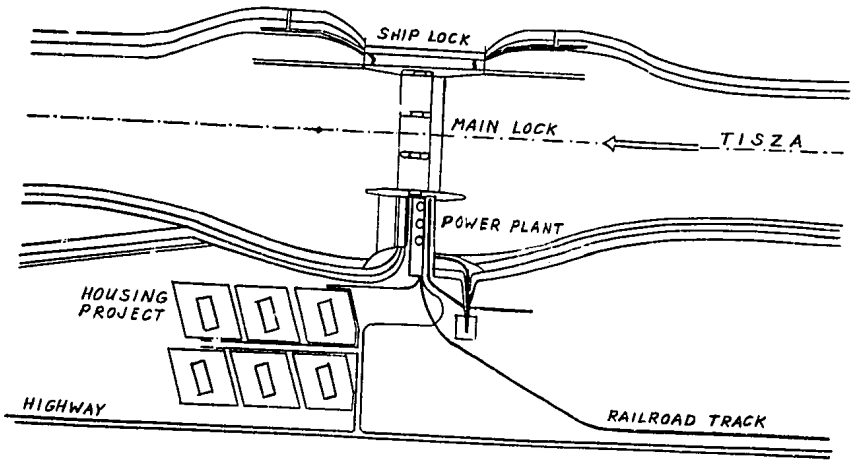

Figure 4. Ground Plan of the Tiszalok Dam Project

The main lock, placed athwart the central river bed, will consist of three movable flood gates and two piers. It will be used to raise the water level high enough for the outlet of irrigation water and to permit the free flow of flood waters and the passage of accumulated alluvial matter and ice. The maximum difference between high and low water levels will be 7.5 meters. The dam will make the Tisza navigable for a length of 80 kilometers, as far as Dombrad, and the Bodrog, for a length of 50 kilometers, as far as Hungary's border, thus creating 130 kilometers of new navigable waterways.

The hydroelectric plant will be equipped with three large Kaplan-system turbines, each nearly 5 meters in diameter and capable of handling 95 cubic meters of water per second.

The ship lock will have an interior length, as measured between the gates, of 85 meters, a width of 12 meters, and a minimum depth of 3 meters. This construction will enable it to handle barges of up to 1,000-1,200 tons.

Construction of the Tiszalok Dam

As mentioned in the foregoing, the dam will be built in the new channel (Figure 3). The main reason for selecting this location for the dam was the fact that it reduces or entirely eliminates certain construction problems and also has the following operational advantages:

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1. The dam will be located in a straight section, instead of in a river bend, so that the water and ice will flow parallel to the walls of the piers and the cutoff, a feature which is desirable from several viewpoints.

2. By building a cutoff through the Razompuszta bend, the power plant will be located on the left bank which is far above flood level. As a result, the power plant will be accessible even during the highest floods.

The construction site has been protected against floods by a circular dike, and the reinforced-concrete foundation plates of the installations have been sunk 10-13 meters below the water table, depending on its height at various times. The soil in the area of the project, down to a very great depth, consists of fine or medium-fine sand layers, sporadically interspersed with isolated thin clay or mud formations. However, the latter are usually lenticular and, therefore, prevent the infiltration of water between the sand layers.

In the course of the borings and geological tests which preceded planning, it became evident that direct excavation for the foundation was impossible. Therefore, to perform the excavation work in a dry pit, the water table had to be lowered. In lowering the water table, one of two methods had to be employed:

1. The water table can be lowered by digging deep wells. With this method, the number of the wells is usually smaller than the number of wells in the second method, but special equipment, the so-called diver pumps, is needed. Moreover, since the suction range of these pumps never exceeds 6-7 meters, they must be lowered into the wells.

2. The water table can be lowered by multiple-stage lowering. Under this method, after the foundation pit has been excavated down to the ground-water level, a series of wells is sunk around it. These are 8-10-meter-deep shallow wells, surrounded by gravel filter layers. After this first stage is completed, pumping is started, which results in the lowering of the water table near the wells. As soon as the water table between opposite rows of wells has fallen by approximately 2-3 meters in the whole area of the foundation pit, excavation is continued in this dry upper layer. The operation is then repeated for successive lower layers.

For the construction of the Tiszalok dam, the latter method was adopted. Test pumpings indicated that drainage by deep wells was inexpedient, because, by penetrating into the somewhat coarser subsoil, this would increase the volume of water to be pumped to an extent which would make this method very difficult. The multiple-stage method appeared preferable and the results achieved thus far have borne out the calculations.

Construction of the installations for the lowering of the ground-water level started in October 1950 and pumping, 2 months later. On the site of the power plant (the lowest part of the construction area), the water table was lowered to the required depth by mid-August 1951. The water level was reduced in three stages. In this work, only 155 filter wells had to be sunk, as compared to the 210 originally planned. In preliminary tests, the pumping requirement had been estimated at 2.3-3 liters per second per well. Actually, however, only 2-2.2 liters per second per well had to be pumped to reduce the water level to the necessary depth.

Construction of the concrete foundation plate for the power plant was begun in early August 1951, and the suction canals, the foundation plate of the front canal, and the rear bed behind the suction canal were completed by the end of the year. This represents a total of 15,000 cubic meters of reinforced-concrete construction work, or 20 percent of the total foundation work for the

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entire project. It may be pointed out that this foundation work was performed in the lowest and, therefore, most difficult part of the project. In future foundation work, it will not be necessary to reduce the water table to a similar depth.

The good results which have already been obtained now justify confidence in the further progress of the Tarbela project. The preliminary work and scientific investigations, as well as the major part of the diversion, have been completed. Excavation for the dam and the new Indus channel is progressing rapidly, and excavation of the principal irrigation canal has been started. A huge Soviet-made self-propelling dredger is removing several million cubic meters of earth. Thus, at the commencement of the Tarbela Dam, after the turbines of the power plant have been placed in operation, the main canal will also be ready to supply irrigation water to the dam construction Plaza region.

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